Terms-of-Trade Impacts of Trade Agreements and the Choice of Trade Policy

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Abstract

This paper studies the impacts and determinants of trade policy. I use data on applied tariff protection of world countries over 2001-2007 to estimate sector-level trade elasticities. I then calibrate a structural gravity model of world trade. I compute the impacts of trade agreements which were implemented and of those which were not. I find that expected real income gains predict the signing of PTAs. Decomposing these gains shows that domestic mill price increases, reflecting market access gains, have a larger impact than the impact on the consumer price index. I also find that larger expected gains from multilateral liberalization reduce the probability to engage in preferential agreements.

Keywords: International trade, Preferential trade agreements, Counterfactual Estimation, Trade creation and diversion.

JEL classification: F13, F12, F47.

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1 Introduction

Preferential trade agreements (PTAs) are growing fast in number, while multilateral trade negotiations are stalling. From 1995 through 2010, the number of PTAs increased fourfold to reach 300 PTAs presently in force (WTO, 2011); the geographical coverage of PTAs has expanded both within and between continents, and with the participation of developed and developing countries. At the same time, negotiations to open trade multilaterally have not made significant progress in recent years.

Given the non-optimality of preferential trade liberalization, and the distorsions associated to it, these facts are worrying. They raise the question of why countries favor discriminatory trade opening, when theory suggests a unilateral and non-discriminatory opening of trade to be optimal. We examine this question by looking at the immediate gains countries may expect from alternative trade policies. These gains are of two types: market access gains, which translate into higher production prices, and real income gains, which benefit consumers by lowering the domestic price index. Our results show that the former are a stronger determinant of trade policy than the latter.

Our approach consists in letting the data on trade policies talk about what guides countries' decisions. We use an exhaustive database of tariff protection for the period 2001-2007, and rely on a simple Armington model of international trade to compute the implied changes in trade and real income for world countries.

First, we characterize each country's trade policy in our period of interest, measuring the impacts of its policy all else equal. We ask in particular if these trade policies tend to reinforce distorsions in the trade structure of countries, by making trade more preferential. Results show disparities across countries: about half the countries in our sample have had a policy which made their trade *more* multilateral, all else equal. This runs counter to the intuition that the overwhelming trend in recent years has been toward more preferentialism, as suggested by the multiplication of PTAs. Rather, our analysis suggests that some countries tend to favor one or the other modes of liberalization, depending on the relative gains they expect from each process.

This observation naturally leads us to ask about the determinants of trade policy choices of countries. What explains that countries choose to engage in PTAs, or to open trade in a non-preferential manner? Previous literature has emphasized that the choice of trade policy results from confronting different interests (Grossman and Helpman, 1995): producers in different sectors tend to favor or oppose an agreement depending on the structure of protection and productivity differences between potential partners, causing them to expect market access gains, or increased import competition. Consumers expect real income gains through lower prices, however they may also expect losses by diversion if distorsions in the tariff structure become important. Computing the impacts of alternative trade policy choices for producers and for consumers, we confront these impacts with the list of actually signed agreements. Results indicate that expected real income gains from signing a PTA predict those agreements that were actually signed; moreover, potential gains from multilateral opening reduce the probability of signing, which confirms the existence of a tradeoff between the two modes of liberalization. However, we also find that the two gains do not carry the same weight in a country's trade policy: gains in production prices have an impact that is about two times larger on the probability of signing.

Finally, we also show that the losses by diversion faced by countries are also a significant predictor of the signing of PTAs, which confirms a contagion or "domino effect" (Baldwin, 1993) being one of the main forces behind the proliferation of PTAs. In other words, countries sign PTAs also for the motive of avoiding the losses from non-preferential access to a partner's market.

Our approach focuses on terms-of-trade impacts of trade policy. By using a multi-sector, endowment model of international trade with Armington differentiation, we restrict the analysis to the short-term effects of trade barrier changes, leaving aside longer-term effects through adjustments of the production structure or technology improvements. Previous literature has shown these terms-of-trade motives to be predominant in driving trade policy (Baier and Bergstrand, 2004). Our results confirm this aspect, and more importantly, show that structural estimates of terms-of-trade have explanatory power for trade policy, above and beyond proxies based on distance and income levels. The use of the Armington endowments model is also justified by its good performance to explain trade data (Anderson and Yotov, 2010b, 2012).

We first present the model and its relation to other models belonging to the "structural gravity" class. We then analyze in a simple example how the impact of preferential tariff reductions on prices and real income varies with the trade elasticity, the relative size of trading partners and pre-FTA trade patterns. Then, we parameterize the model to quantify PTA effects, which boils down to estimating sector-level trade elasticities. This parameter is crucial as it is a sufficient statistic which allows to predict the adjustment of trade and prices to trade policy shocks, in structural gravity models. We estimate these parameters using disaggregated bilateral applied tariff panel data, which allows to control for the endogeneity of trade policy through the use of country-sector fixed effects (Baier and Bergstrand, 2007). Once armed with these elasticity estimates and with our data on applied tariff changes, we compute PTA effects by counterfactual estimation. This allows us to compute the trade and real income impacts implied trade policies as implemented by world countries during the period. Then, we use the method to confront the effects of actual trade policies to those of alternative policies, namely trade agreements and multilateral trade liberalizations.

A large literature has studied the determinants of trade policy. The seminal paper by Grossman and Helpman (1995) builds a political economy framework where governments take into account both voter's interests and industry special interests in deciding over trade agreements. By contrast, we do not enter into the political economy structure of countries, as we do not observe whether groups are organized into lobbies, nor whether there is coordination across sectors in trying to influence trade policy. Rather, we make the implicit hypothesis that net gains to each group, aggregated across sectors, should matter for the government's decisions. This should be the case if the possibility of transfers across groups exists, so that adversely impacted groups can be compensated for their losses. Our results indicate that this is the case only in part. Our results are also related to those in Goldberg and Maggi (1999), who run an empirical test of the model by Grossman (1994). These authors quantify the weight of welfare in the US government's objective function and find it to be very close to 1 (0.99), implying that the US government is close to being a perfect welfare maximizer in its design of tariff structure. By contrast, our analysis based on the signing of PTAs finds robust evidence that world countries' trade policies substantially differ from the welfare-maximizing, overweighting producers' interests over those of consumers.

The use of an endowments model of trade based on Armington differentiation and Dixit- Stiglitz preferences places our paper in the so-called "structural gravity" literature (Anderson and Yotov, 2011; Egger et al., 2011)). It has been recognized that different one-sector models of trade, based on CES preferences, such as Krugman (1979); Eaton and Kortum (2002); Melitz (2003) have in common to generate a gravity equation with a similar structure for trade flows. One consequence is that these models generate the same functional form for the impacts of trade cost changes on prices and real income levels, conditional on trade elasticities and on initial trade levels (Arkolakis et al., 2012). Thus, estimating trade elasticities becomes the key to predict price movements in these models, as this parameter encompasses the different margins of adjustment described in these models. This motivates our approach, which consists in estimating sector-level trade elasticities, in order to compute the impacts of various trade policy scenarios on price and real income levels. The validity of these results beyond the Armington model will be discussed in detail in the text.

In addition, relying on sector-level elasticity estimates instead of a single PTA parameter allows us to account for heterogeneity in PTA effects due to the width and depth of tariff reductions.[1]

Finally, by assuming fixed endowments the model features an inelastic export supply curve, similarly to models of terms-of-trade manipulation and optimal tariffs (Broda, Limao and Weinstein, 2008, Ludema and Mayda, 2011). Therefore, as in these models, there is a positive association between market power and tariffs:

[1] Another difference is that we solve the model in full general equilibrium, allowing for export prices to affect trade through countries' income, contrary to antecedents in which trade changes are computed while implicitly keeping countries' income as fixed (Anderson and Wincoop, 2003; Anderson and Yotov, 2010a; Baier and Bergstrand, 2009; Egger et al., 2011).

countries have an incentive to set higher tariffs on imports from partner countries in which their market share is higher, while opening trade in priority with those where their market power is lower.[2]

The rest of the paper is as follows. In section (2), we present the model, and discuss its relation to the class of structural gravity models, and the possible generalization of our results in this framework. We then use a simple, 3-country version of the model to analyze its implications for the effects of PTAs on trade, real income and welfare. In section (4), we estimate the trade elasticities. In section (5), we compute the price and real income impacts of trade policy implemented by world countries during our period of study. Then, in section (6), we study the determinants of the signing of PTAs. Section (7) concludes.

2 Model

This section presents the multi-sector Armington model, and the method used to calibrate it and to solve it in comparative statics simulation exercises. We then discuss the relationship between this model and other models of trade featuring additional margins of adjustment to trade cost changes, such as the Krugman (1979), Eaton and Kortum (2002) and Melitz (2003) models. We make the point that the changes in prices and real income levels which we compute in our model can, under some conditions, be generalized to these richer frameworks.

Model structure

The model features multiple sectors, covering agriculture, mining and manufacturing activities.[3] We model preferences with a Cobb-Douglas structure across sectors and CES (constant elasticity of substitution) across varieties within each sector. Goods in each sector k are produced using a specific factor, of which each country i has a

[2] However, contrary to those models, there is no optimal positive tariff, because the gain to consumers always dominates over losses to domestic producers. This is due to the hypothesis of imperfect substitution between domestic and imported goods. Thus, issues related to negotiations over tariffs are not considered here.

[3] In the empirical application, each sector corresponds to one code in revision 3 of the International Standard Industrial Classification (ISIC), maintained by the UN.

fixed endowment L_k^i. Within each sector, we make the Armington assumption that goods are differentiated by country of origin (consumers perceive varieties produced in different countries as imperfect substitutes).

Demand is thus given by:

$$c_{ij}^k = (p_i^k)^{-\sigma_k}.\left(\frac{\tau_{ij}^k}{P_j^k}\right)^{1-\sigma_k}.E_j^k, \tag{1}$$

where c_{ij}^k is the demand of country j's consumers for the i variety of good k, p_i^k is the f.o.b (free on board) price of that variety, τ_{ij}^k is the iceberg trade cost on trade from i to j in sector k (which is to include geographic and trade policy components of trade costs), P_j^k is country j's price index in that sector and σ_k is the elasticity of substitution between varieties of that good. E_j^k is country j's expenditure on good k, given by $E_j^k = \alpha_k.Y_j$, where α_k is the Cobb-Douglas parameter share of expenditure on good k and Y_j is country j's total income[4].

Sectors are thus modeled as largely independent in the model: labor cannot be reallocated across sectors, and consumers spend a fixed share of their expenditure on each sector (Cobb-Douglas assumption)[5]. We thus abstract from factor-based comparative advantage effects, as well as from inter-sectoral linkages (e.g. vertical relations). One reason for doing this is that, as documented below, results on price responses to trade cost changes in the one-sector Armington model are, under some conditions, valid under a larger class of one-sector models. This is still true of price responses in each sector of our model, which functions like a superposition of one-sector Armington models. This restrictive assumption allows to estimate price responses to trade policy changes using a limited list of statistics (trade elasticity, trade levels, tariff changes); which would not be possible if accounting for inter-sectoral linkages.

[4]Note: parameters of the demand function α_k and σ_k are assumed to be identical across countries.

[5]This modeling choice is motivated by the fact that our sectors (as defined by ISIC codes) are sufficiently distinct to allow little substitution.

The nominal bilateral trade flow between i and j in sector k is given by

$$X_{ij}^k = \left(\frac{p_i^k.\tau_{ij}^k}{P_j^k}\right)^{1-\sigma_k}.E_j^k. \tag{2}$$

with P_j^k the ideal price index for j's consumers in country k, given by:

$$(P_j^k)^{(1-\sigma_k)} = \sum_i (p_i^k.\tau_{ij}^k)^{1-\sigma_k}. \tag{3}$$

A quantity Q_i^k of good k is produced by a representative firm in country i, using a specific factor L_i^k which is in fixed supply. Without loss of generality, one can set the factor requirement to 1, which yields identity between sector-level wages w_i^k and the f.o.b. price of the good:

$$w_i^k = p_i^k \tag{4}$$

The market clearing condition for each variety of each good is written as:

$$\sum_j X_{ij}^k = p_i^k.Q_i^k, \tag{5}$$

where the sum is over all destinations, including domestic sales of the good.

Finally, each country's total income Y_j is equal to the total value of sales in all sectors:

$$Y_j = \sum_k p_j^k.Q_j^k \tag{6}$$

The structural gravity equation

Anderson and Wincoop (2003) define the aggregate of demand-weighted trade costs faced by an exporter as the exporter's 'multilateral resistance'. This multilateral price (we use here both terms interchangeably) is defined as:

$$(\Pi_i^k)^{1-\sigma_k} = \sum_j \left(\frac{\tau_{ij}^k}{P_j^k}\right)^{1-\sigma_k} \frac{E_j^k}{Y_w^k}, \tag{7}$$

where Y_w^k is the total nominal value of world production of good k: $Y_w^k = \sum_i p_i^k Q_i^k$. Using this definition and equation 5, one obtains the relationship between f.o.b prices and multilateral resistance terms as:

$$(p_i^k)^{\sigma_k} = \frac{Y_w^k}{Q_i^k}.(\Pi_i^k)^{1-\sigma_k}. \quad (8)$$

Combining this expression with the trade demand equation 2, one obtains the gravity equation for nominal trade flows:

$$X_{ij}^k = \left(\frac{\tau_{ij}^k}{P_j^k \Pi_i^k}\right)^{1-\sigma_k} . \frac{E_j^k Y_i^k}{Y_w^k}. \quad (9)$$

which expresses bilateral trade as a function of bilateral trade costs, multilateral prices (Π_i^k) and (P_j^k) (labeled exporter and importer multilateral resistance terms, respectively, by Anderson and Wincoop (2003)), and the income and expenditure levels of the exporter and importer, E_j^k and Y_i^k.

One advantage of this expression is that its structure is common to distinct trade models. More precisely, trade models such as Krugman (1979), Eaton and Kortum (2002) and Melitz (2003), all yield a "gravity equation" for trade, where bilateral trade flows are a constant-elasticity function of bilateral trade costs and of multilateral price terms for the exporting and importing countries. Across models, the trade elasticity (equal to $1 - \sigma_k$ in the case considered here) will depend on different parameters of the model.[6]

Thus, the trade elasticity can be estimated using equation 9, using a measure of time-varying bilateral trade costs and country-sector fixed effects which control for the exporter and importer terms P_j^k and E_j^k, Π_i^k and Y_i^k. This obtained estimate of the trade elasticities, $\hat{\sigma}_k$, should thus be viewed not as specific to the Armington used here, but valid under more general assumptions which are compatible with the structural gravity equation.

In turn, the relative price changes in response to trade cost changes, are also

[6] For example, in the Armington model used here, as in the Krugman (1979) model, it is simply a function of the CES elasticity of substitution. In Eaton and Kortum (2002) and in Melitz (2003), it depends on the CES elasticity and on the parameter governing the distribution of firms productivities.

invariant across a class of models, conditional on the value of trade elasticities and initial trade values. This motivates our empirical strategy: we first estimate sector-level trade elasticities, then compute price and income changes resulting from trade cost changes (preferential agreements), in a comparative statics exercise whose validity extends beyond the Armington model. This result is discussed in the section 2.1.

Resolution method Once estimates of the trade elasticities for each sector are obtained (section 4), the comparative statics exercises in sections 5 and 6 are carried by solving the model first in the reference year 2001 with data for applied tariffs in that year and total production by country and sector[7]; then in alternative scenarios where changes in tariffs are applied, while production values and non-tariff components of trade costs are maintained constant. For each set of tariff values, the model is solved using an iteration algorithm. Equations 8, 3 and 6 are solved in the variables p_i^k, P_j^k and Y_j, iterating until the relative error in each component of the equations is lower than 0.1%. The system admits a unique equilibrium once a normalization is imposed: we set $Y_w = \sum_j Y_j = 1$.

In each scenario, changes in prices and income levels are then measured as the relative change between the equilibrium in benchmark year 2001 and the new equilibrium after tariff changes are applied.

2.1 Validity of our results in more complex models

Results for relative price changes in response to trade cost changes, obtained in the Armington model presented above can be generalized to a broader class of models of trade. The basic intuition behind this result is that a number of one-sector models of trade generate trade equations with the same "gravity" structure for the trade equation, where the *trade elasticity* - the elasticity of trade with respect to trade costs and wages - is a function of different parameters of the model, reflecting different margins of adjustment to trade shocks.

In turn, changes in the f.o.b. prices of variety and the ideal price index in each

[7]See section 4 for details on the data used.

country, resulting from a change in trade costs, will be driven by the constant-elasticity dependence of trade to prices. Thus, the relative changes in prices, *conditional on the trade elasticity* (as well as on initial trade levels) will be unchanged across these models. Note that this does not imply equivalence across these models, but rather, that the trade elasticity is a sufficient statistic to compute a number of price changes.

Arkolakis et al. (2012) present a set of conditions defining a class of models where this result holds. These include the Krugman (1980) model of trade with symmetric firms in monopolistic competition in each country; the Eaton and Kortum (2002) model of Ricardian comparative advantage, and the Melitz (2003) model with heterogeneity in firm productivity.

The three required "macro-level restrictions" are: that trade is balanced; that the share of profits in a country's total revenues is constant; and that the import demand system is of the form:

$$X_{ij} = \frac{\xi_{ij}.N_i.(w_i\tau_{ij})^{\epsilon}.\ Y_j}{\sum_i' \xi_{i'j}.N_i'.(w_i'\tau_{i'j})^{\epsilon}} \tag{10}$$

where X_{ij} is trade value from country i to j, N_i is the number of firms operating in country i, ξ_{ij} is a function of parameters distinct from τ; Y_j is country j's income level; and ϵ is the "trade elasticity", which is a function of different parameters in different models [8]

It is relatively straightforward to show that this set of conditions leads to the following system of equations:

$$\hat{w}_i = \sum_l \frac{\lambda_{il}\hat{w}_l Y_l(\hat{w}_i\hat{\tau}_{il})^{\epsilon}}{Y_i \sum_r \lambda_{rl}(\hat{w}_r\hat{\tau}_{rl})^{\epsilon}} \tag{11}$$

and

[8] Condition 10 is called R3' in Arkolakis et al. (2012) and is more restrictive than condition R3 under which their most central result on the welfare gains from trade is derived. This central result states that welfare change from a shock to trade costs, *conditional on the change in import penetration*, is constant across a class of models. This does not mean that these models generate the same welfare changes from a given trade policy shock, as the import penetration reaction can differ across models. Thus, in order to derive the stronger result, of interest to us, that relative price changes, for a given shock on trade costs, are invariant, condition R3' is necessary.

$$\hat{P}_j = [\sum_i \lambda_{ij}(\hat{w}_i\hat{\tau}_{ij})^{\epsilon}]^{-1/\epsilon} \tag{12}$$

where $\hat{z}$ denotes the ratio of final to initial value of variable z, z'/z, resulting from a arbitrary change in trade costs; and $\lambda_{ij} = \frac{X_{ij}}{E_j}$ is the initial share of imports from i in country j's total expenditure.

This system defines the relative change in wages $\hat{w}_i$ as an implicit function of initial trade shares and relative changes in trade costs.

Our Armington model of trade verifies these assumptions: trade is balanced; profits are zero, due to the hypothesis of perfect competition; and trade flows are given by the expression 10, with the number of firms and the parameter ξ being uniformly one; and $\epsilon = 1 - \sigma$, with σ our CES elasticity of substitution.

This ensures that the relative changes in wages (or equivalently, f.o.b. prices) $\hat{w}_i$ and in the consumption price index $\hat{P}_j$ are given by conditions 11 and 12, in this class of models, and thus that these changes, conditional on trade elasticities and trade shares, are invariant across these models.

These models include some of the models often used in the trade literature. One important common characteristic of these models is that they assume CES preferences[9]. In particular, this implies that markups will be constant: pro- or anti-competitive effects of trade openness are thus not accounted for.[10]

3 Impact of a PTA on prices: a simple example

In this section, we use a simple example with a three-country, one-sector version of the Armington model, to illustrate the impacts of preferential trade liberalization on production prices and real income in this model.

We consider the following stylized model with three countries denoted A, B and C, producing and trading differentiated varieties of the same one good. We assume

[9] In principle, condition 10 does not imply that preferences are CES, as this condition characterizes the import demand function as a result of both preferences and supply side responses. In practice, commonly used models verifying 10 all assume CES preferences.

[10] See e.g. Neary and Mrazova (2013) for a discussion of the relation between demand elasticities and pro-competitive effects in a more general framework.

that A is at an equal distance from B and C, with a larger distance between B and C. In practice, we set initial trade costs as:

$$\tau_{ij} = 1 \quad if \quad i = j$$
$$\tau_{AB} = \tau_{AC} = 1.5$$
$$\tau_{BC} = 2$$

$$tradecost_{ij} = (1 + AV_{ij}).\tau_{ij} \tag{13}$$

where AV is the ad-valorem equivalent of trade policy barriers applied by j on imports from i. That is, bilateral trade costs result from a combination of a "geographical" component and of policy barriers applied by countries.[11]

We initially set the size of countries A, B, C to 1, 10 and 5; a country's size being here equal to its labor endowment, or equivalently to the volume of its production.

We assume that countries initially apply a MFN, non-discriminatory tariff to all imports, and set it to 30%. We consider the case of a bilateral PTA signed between countries A and B, which sets tariffs between these two countries to 0.

We focus on the impact of the PTA on prices in country A. The questions of interest to us, here and in the rest of the paper, are the impact of the PTA on the producer price p_A; the consumer price index P_A; and the country's real income $Y_A = \frac{p_A.Q_A}{P_A}$.[12]

Figure 1 represents the relative change in production price p_A: we have here two parameters varying, the size of the partner country B, which goes from 1 to 20; and the elasticity of substitution σ, which varies between 1 and 10.

The figure shows that the impact of the PTA on production price changes sign

[11] This is similar to the functional form which will be used to model trade costs in the empirical part, where the geographic component will account in particular for distance and contiguity.

[12] In the case of policy barriers being in the form of tariffs, the real income of a country includes the share of revenues from trade barriers which is rebated: $Y_A = \frac{p_A.Q_A + \rho.\sum_{i=B,C} AV_i X_{iA}}{P_A}$ with ρ the share of revenue rebated. We will check that modifying ρ does not modify qualitatively our results.

depending on these two parameters. In particular, in the low substitution case, the impact is positive, while it becomes mostly negative in the high-σ region. This reflects two competing effects: on one hand, the PTA grants preferential access to country B's market, which allows A's producers to raise their production price, the more so, the more inelastic the demand for their variety is. On the other hand, the PTA entails reciprocal tariff reductions, which implies a competition effect on A's domestic market: this tends to bring the price of A's variety lower, with this effect being larger if competing varieties from A and B are more substitutable.

These two effects are generally larger when the size of the partner country increases. Thus, in a low-σ sector, one would expect producers in country A to prefer a PTA with a large partner (all else equal); while in a high-σ where import competition dominates, they would prefer a PTA with a smaller partner country.

Figure 2 displays the impact of the PTA on country A's consumer price index (the CES ideal price index). The impact is negative as the PTA lowers the aggregate price of consumption in the country; it is displayed in absolute value here. The figure shows that consumers stand to gain from the PTA, the more so when σ is low and the size of the partner country increases. Interestingly, the gradient of the impact is not aligned with that of the production price impact: for example, in the high-σ region, the gain increases with the partner's size, while the impact on production price becomes more negative. This illustrates the divergence of interests in trade policy: in a country trading a good with high trade elasticity, a policy focused on maximizing production prices would prefer a PTA with a small partner country, while favoring the gains to consumers would lead to choose a PTA with a large country.

Figure 3 displays the impact of the PTA on country A's real income. It shows that the larger gains in real income are obtained in the high-σ, high-Q region. The PTA lowers the consumer price index in country A, through cheaper imports from partner country B and through the import competition effect, which also lowers the domestic variety's price. These effects are larger in the high-σ region and dominate the negative impact on domestic prices, causing a larger real income gain. This illustrates the divergence between the objectives of maximizing production prices versus real income.

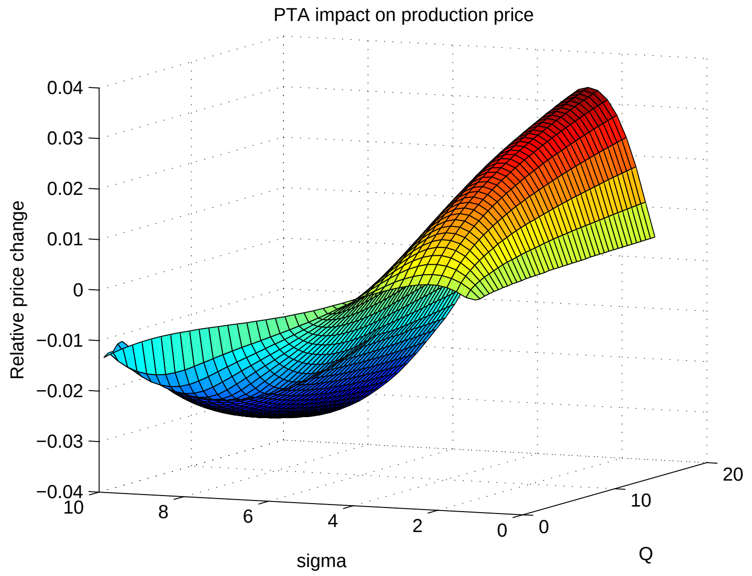

Figure 1: PTA impact on country A's production price

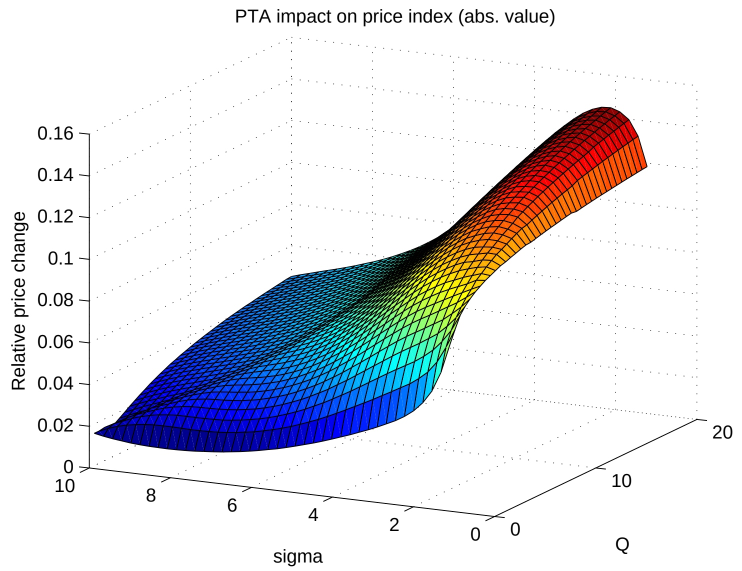

Figure 2: PTA impact on country A's consumer price index

Another example of this divergence is given on figure 4, which focuses on changes in production prices and in the consumer price index, in the case $\sigma = 8$, as a function of the partner country's size Q. The figure highlights the non-linearities in price

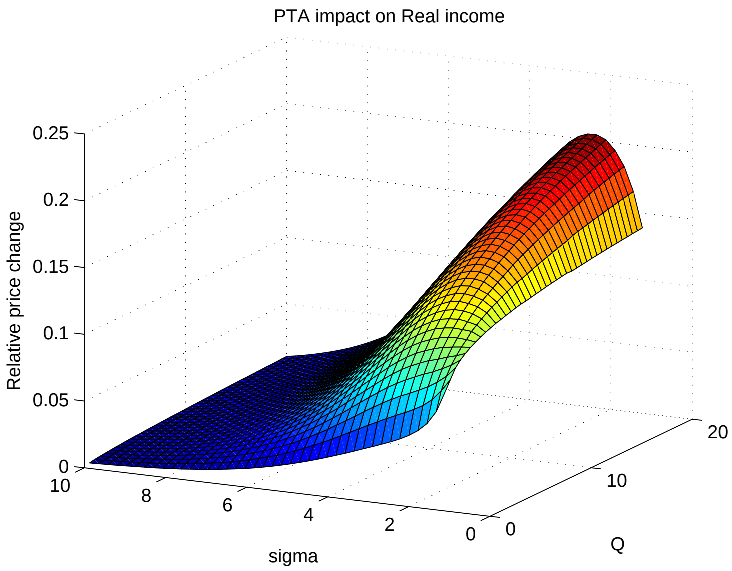

Figure 3: PTA impact on country A's real income

changes in this model and shows that the maxima of the two price functions do not coincide.

This highlights again the divergence between the two objectives: assuming that a country would face the alternative of signing a PTA with two countries differing only by their size, the optimal choice would differ depending on whether policymakers favor the objective of maximizing production prices, or consumers' real income level.

The rest of the paper will attempt to use the information on the PTAs signed by world countries as indicative of the underlying objective pursued by signing governments. The same Armington model, but with more countries, multiple sectors will be used. Variations in initial trade level and sectoral composition, distance to potential PTA partners and third countries, will generate variations in the potential impact of a PTA on signing countries' production prices and real income. Our approach consists in confronting these impacts to the observed choice of PTAs to infer information on the objective functions governing trade policy choices.

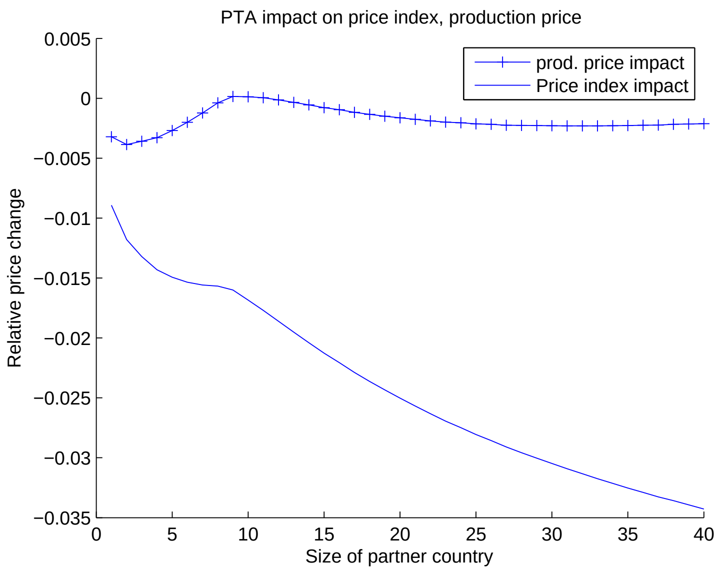

Figure 4: Incidence on importer's price index

4 Estimation of sector elasticities

Empirical specification The estimation of the effects of PTAs is done in two steps. In this section we estimate elasticities of substitution at sector level to parametrize the model. Next we estimate the effects of trade policy changes. Taking the log of equation (9) yields

$$\ln X_{ij}^k = \ln \frac{Y_i^k}{Y_W^k} + \ln \frac{E_j^k}{Y_W^k} + (1-\sigma^k).(\ln \tau_{ij}^k - \ln(P_j^k.\Pi_i^k)). \tag{14}$$

A functional form of trade costs is needed to estimate this equation. In line with the common practice in the literature, we assume the following log-linear stochastic form:

$$\tau_{ij}^k = (1+\text{Tariff}_{ij}^k).d_{ij}^{\rho^k}.e^{\alpha^k \text{Contig}_{ij}}.e^{\beta^k \text{Comlang}_{ij}}.e^{u_{ij}^k}, \tag{15}$$

where Tariff_{ij}^k is the ad-valorem equivalent of tariff barriers on i's products exported to j in sector k, d_{ij} is the distance between i and j and u_{ij}^k represent unobserved bilateral trade cost determinants. We also add two dummy variables: Contig_{ij}, which is unity if countries/regions i and j are contiguous, and Comlang_{ij}, which is unity if i and j share an official language.

Plugging the functional form of trade costs into (14) and adding time subscripts to stress the point that some of the variables are time varying give us:

$$\begin{aligned}\ln X_{ijt}^k &= \ln \frac{Y_{it}^k}{Y_{Wt}^k} + \ln \frac{E_{jt}^k}{Y_{Wt}^k} + (1-\sigma^k).(\ln(1+Tarif f_{ijt}^k) - \ln(P_{jt}^k) - \ln(\Pi_{it}^k)) \\ &+ (1-\sigma^k).(\rho^k.d_{ij} + \alpha Contig_{ij} + \beta Comlang_{ij}) + \epsilon_{ijt}^k, \end{aligned}\tag{16}$$

where ϵ_{ijt}^k is the stochastic error term. We estimate this equation separately for each sector. We introduce exporter-time (λ_{it}) and importer-time (λ_{jt}) fixed effects, which enables us to control fully for unobserved sector-level country shares of world production and expenditure, as well as for country multilateral price terms for each sector. Thus our specification is the following:

$$\ln X_{ijt}^k = \beta^k \ln(1+\text{Tariff}_{ijt}^k) + \gamma^k \ln d_{ij} + \delta^k \text{Contig}_{ij} + \eta^k \text{Comlang}_{ij} + \lambda_{it} + \lambda_{jt} + \epsilon_{ijt}^k. \tag{17}$$

In this equation, coefficient β^k gives us directly the estimate of $(1-\sigma^k)$, while γ gives us the estimate of the product $(1-\sigma^k).\rho^k$, of which we can deduce ρ; we can similarly obtain the effects of contiguity and common language on trade costs.

Data We estimate the sector-level gravity equation using nominal bilateral trade values from the BACI trade database.[13] Trade data at product Harmonized System (HS)-6 digit level are aggregated at the International Standard Industrial Classification (ISIC) rev.2 level (79 sectors). We see this level of aggregation as consistent with the definition of sectors in the model.[14] All world trade is considered, aggregating flows into 68 countries/regions to keep the model tractable. This estimation strategy, which reduces the high dimensionality of data, is common in the literature (see Anderson and van Wincoop, 2003 and Anderson and Yotov, 2010).

Data on distance, contiguity and languages are taken from the distance CEPII database.[15] Tariff data are obtained from the CEPII MacMap database (Bouet *et al.*, 2008). This data set contains data on bilateral applied tariff protection for the years 2001, 2004 and 2007. Data on *ad-valorem* and specific tariffs, and on tariff quotas, are converted into *ad-valorem* equivalents using unit values data for the year 2001. Thus, our tariff variable is a comprehensive measure of applied tariff protection, which enables us to track changes in tariff protection due to preferential agreements.[16] Importantly, this enables us to observe precisely the content of PTAs, and to observe variations across PTAs in sector coverage, extent of tariff reductions and time period of implementation.[17] Note that running our estimates on three-year intervals allows us to obtain stable estimates, while the use of yearly data has been shown to yield unstable gravity estimates, due to delays in the adjustment to trade

[13]The BACI trade data set is built by the CEPII (see `www.cepii.fr/anglaisgraph/bdd/baci.htm`).

[14]Recall that the model assumes a Cobb-Douglas structure of demand over sectors. Estimating the model at a product level (e.g. HS-6 classification) would thus implicitly impose a substitution elasticity of 1 over HS-6 products, while the fine level of detail of this classification implies that this elasticity is certainly higher.

[15]See `http://www.cepii.fr/francgraph/bdd/distances.htm`.

[16]Tariff values at product level are aggregated at the level of ISIC-sectors using the 'Regions of Reference' method, thus weighting tariff lines by trade values for the region to which the importer belongs. This mitigates biases in simple trade-weighted aggregates. For more on this see Bouet *et al.* (2008).

[17]Note that we also observe changes in applied tariffs which occur outside the framework of PTAs.

shocks (Olivero and Yotov, 2012). This also allows to filter out business cycle effects.

In estimating equation (17), we face the problem of endogeneity of trade policy, here of the tariff variable. However, this problem is significantly reduced by the use of detailed tariff data, instead of aggregate trade policy indicators such as PTA dummies. Indeed, tariff data at sector level offer considerably more variation. We exploit the fact that trade policy is decided at aggregate level (through multilateral and preferential agreements) so that most tariff changes at sector level can be seen as exogenous from the point of view of the industry.[18] This variation comes from differences (1) in initial pre-PTA tariff level; (2) in coverage of PTAs (that implement partial reduction of tariffs across products); and (3) in implementation of tariff reductions over time.

Note also that our use of detailed tariff data allows for a more direct estimation of elasticities, in contrast to studies focusing on the effect of distance or borders on trade (see e.g. Anderson and Yotov, 2011, Hummels, 1999). Here sector elasticities are directly obtained from the coefficients on tariff variables (the coefficients are $1-\sigma^k$), so that the knowledge of the elasticity of trade costs to distance and other variables is not needed.

Estimation method We use an Ordinary Least Squares estimator with Country-Year Fixed Effects (OLS-CYFE) to estimate the 72 sector-level elasticities. The country-year fixed effects (λ_{it} and λ_{jt}) control fully for importer and exporter time-varying variables: import price indices, exporter f.o.b prices, exporter and importer shares of production and expenditure demand in world total; and any other omitted variable such as those related to institutions.

Results. Table (8) in appendix A displays the estimation results. The table displays the value of the tariff coefficient (corresponding to $1-\sigma^k$ in the model), the associated standard error and the number of observations used for the estimation. Consistently with the CES preferences in our model, which imply that $\sigma^k \geq 1$ in all sectors, we find negative coefficients in all sectors.

[18] Note that this is true in particular for manufacturing sectors which are considered here, given that all trade agreements considered apply a quasi-total tariff dismantlement in manufacturing.

The values we obtain are in the range [1,20; 13.9], with a mean value at 5.37. This is consistent with estimates from other studies; for instance, the Feenstra (1994) method applied to 56 ISIC sectors yields estimates ranging from 3.1 to 28, with mean 6.7 (Imbs and Mejean, 2009).

An additional check of the consistency of our sector-level estimates consists in comparing our results with the classification of traded goods in homogeneous versus differentiated goods, proposed by Rauch (1999). Indeed, the elasticity of substitution σ^k is in average 3.69 higher among homogeneous sectors than among the differentiated ones [19]

[19] Our ISIC rev.2 sectors are classified as homogeneous if they contain more SITC products classified as homogenous than differentiated.

5 Price and real income impacts of PTAs, 2001-2007

Armed with our estimates of the parameters of the model, we start in this section by estimating the impact, on production prices and real income levels, of the trade policy that was implemented by world countries during the 2001-2007 period. In the next section, we will estimate the impacts of alternative trade policies.

5.1 Price impacts of PTAs

First, we ask whether PTAs benefit at all to countries which sign them. Theoretical insights have shown that a country may face a loss from distortions created in import prices, so that a preferential trade opening may in some cases be detrimental to domestic welfare. We use our model and data on tariff protection changes for the 2001-2007 period to compute the implied impacts of PTAs active in this period, looking at changes in real income of signing countries.

Recall that this exercise gives us a lower bound estimate of the total effect of preferential liberalization on real income, as these estimates only take into account the changes in tariff barriers implemented by PTA partners. Moreover, the model focuses on the effects of changing terms-of-trade, while additional potential gains through changes in specialization and productivity improvements are not taken into account.

Second, we decompose those changes in real income into two components: production prices and the consumption price index.[20]

This decomposition aims to distinguish the two sources of benefits from PTAs: on one hand, it lowers import prices, as well as domestic prices through the competition effect. This benefits consumers in the country, by raising their income in real terms. On the other hand, reciprocal tariff reductions in the partner country increases access to this market, which allows domestic producers to raise their mill price.

Tables 1 and 2 display the results of this exercise for the list of all active agree-

[20] Production prices and the consumption price index are aggregated across sectors. The aggregate production price is the average of sector prices weighted by the sector share in total production value. The aggregate ideal price index is the Cobb-Douglas aggregate of sector-level CES price indices.

ments during the period.[21]

These results show a large variation in the real income impacts of PTAs and in the distribution of these impacts across agents within partner countries. Consumer gains - in the form of a reduction of the domestic price index - vary between -0.82 and 2.2%. Producer gains - increased market access, allowing a rise in production prices - vary between -0.15 and 1.56%. The amplitude of the price impacts of PTAs is varying with trade shares between partners, trade composition, pre-agreement tariff levels, and with the magnitude of tariff reductions. In particular, section 3 illustrates how the trade elasticity and the relative size of trade partners modify the price impacts.

[21] We use the data for the list of signed PTAs which is maintained by José de Sousa, http://jdesousa.univ.free.fr/data.htm. Among all PTAs which were signed up to 2007, we consider as "active" during the period 2001-2007, those for which the average tariff decrease in that period exceeded 10%. This allows to put aside those where most of the tariff dimanstlement took place out of our time window.

Table 1: Price and real income impacts of PTAs (%), 2001-2007

Country	Partner	Import prices	s.d.	Production prices	s.d.	Real income	s.d.
Algeria	Egypt	-0.00	0.00	-0.00	0.00	0.00	0.00
Algeria	EU	-1.53	0.06	-0.02	0.02	1.51	0.05
Argentina	Brazil	-0.18	0.01	0.17	0.01	0.35	0.02
Argentina	Bolivia	-0.06	0.03	0.05	0.02	0.11	0.01
Argentina	Chile	-0.53	0.05	0.23	0.02	0.76	0.06
Bolivia	Paraguay	-0.06	0.01	0.06	0.01	0.12	0.01
Bolivia	Uruguay	-0.04	0.00	0.03	0.01	0.06	0.01
Bolivia	Argentina	-0.53	0.05	0.37	0.07	0.90	0.05
Bolivia	Brazil	-0.63	0.04	0.37	0.04	1.00	0.06
Bolivia	Mexico	-0.45	0.01	0.05	0.01	0.50	0.02
Brazil	Bolivia	-0.03	0.00	0.04	0.01	0.07	0.01
Brazil	Uruguay	-0.01	0.00	0.01	0.01	0.02	0.01
Brazil	Argentina	-0.08	0.01	0.08	0.01	0.16	0.01
Brazil	Chile	-0.07	0.00	0.04	0.01	0.11	0.01
Chile	Uruguay	-0.03	0.00	0.03	0.02	0.06	0.02
Chile	Brazil	-0.16	0.01	0.16	0.03	0.33	0.03
Chile	Korea	-0.05	0.01	0.03	0.02	0.08	0.02
Chile	Argentina	-0.56	0.05	0.54	0.05	1.10	0.09
Chile	China	-0.12	0.01	0.07	0.03	0.19	0.03
Chile	EFTA	-0.07	0.01	-0.04	0.02	0.03	0.02
Chile	EU	-1.06	0.03	-0.01	0.04	1.05	0.05
Chile	USA	-1.07	0.04	-0.02	0.02	1.04	0.05
China	Chile	-0.00	0.00	0.01	0.00	0.02	0.01
China	Indonesia	-0.04	0.01	0.00	0.00	0.04	0.01
China	Malaysia	-0.08	0.03	0.04	0.00	0.12	0.03
China	Thailand	-0.09	0.01	0.01	0.00	0.10	0.01
China	Hong-Kong	-0.43	0.04	-0.15	0.02	0.28	0.03
Colombia	Mexico	-0.63	0.01	0.04	0.02	0.68	0.02
EFTA	Chile	0.00	0.02	0.01	0.00	0.01	0.02
EFTA	Turkey	-0.02	0.03	-0.00	0.00	0.02	0.03
EU	Chile	0.01	0.00	0.02	0.00	0.01	0.00
EU	Egypt	0.01	0.00	0.01	0.00	0.01	0.00
EU	Algeria	0.01	0.00	0.01	0.00	0.01	0.00
Egypt	Ghana	-0.06	0.28	-0.02	0.09	0.05	0.20
Egypt	Algeria	-0.07	0.28	-0.02	0.09	0.05	0.20
Egypt	South Africa	-0.09	0.30	-0.03	0.09	0.07	0.21
Egypt	Morocco	-0.13	0.32	-0.02	0.10	0.11	0.23
Egypt	Lebanon	-0.15	0.29	-0.03	0.09	0.12	0.20
Egypt	Tunisia	-0.18	0.33	-0.01	0.10	0.17	0.24
Egypt	Syria	-0.16	0.30	-0.06	0.09	0.10	0.21
Egypt	Jordan	-0.20	0.30	-0.03	0.09	0.16	0.22
Egypt	Turkey	-0.28	0.33	-0.05	0.10	0.22	0.24
Egypt	EU	-2.21	0.38	-0.15	0.11	2.06	0.29

Bootstrap standard errors. The table considers the impact of all PTAs active in the period 2001-2007, on each country's prices and real income. Each line displays the impact for the first named country, implied by its PTA with the second country.

Table 2: Price and real income impacts of PTAs (%), 2001-2007 (Cont'd)

Country	Partner	Import prices	s.d.	Production prices	s.d.	Real income	s.d.
Ghana	Egypt	-0.02	0.00	0.00	0.01	0.02	0.01
Ghana	Morocco	-0.03	0.00	0.01	0.01	0.04	0.01
Hong-Kong	China	0.82	0.06	1.57	0.12	0.75	0.07
Indonesia	China	-0.03	0.00	0.11	0.02	0.14	0.01
Jordan	Egypt	-0.07	0.01	0.21	0.03	0.28	0.03
Jordan	Morocco	-0.01	0.00	0.05	0.01	0.06	0.01
Jordan	Tunisia	-0.03	0.00	0.06	0.01	0.09	0.01
Jordan	Lebanon	-0.10	0.01	0.05	0.01	0.15	0.01
Jordan	Syria	-0.20	0.03	-0.00	0.01	0.20	0.03
Kenya	South Africa	-0.14	0.02	0.00	0.01	0.14	0.02
Korea	Chile	-0.07	0.02	-0.01	0.01	0.06	0.03
Lebanon	Egypt	-0.02	0.00	0.15	0.01	0.16	0.01
Lebanon	Tunisia	-0.00	0.00	0.06	0.01	0.07	0.00
Lebanon	Morocco	-0.00	0.00	0.04	0.00	0.04	0.00
Lebanon	Jordan	-0.05	0.01	0.08	0.01	0.14	0.01
Malaysia	China	-0.23	0.03	0.19	0.02	0.43	0.03
Malaysia	Thailand	-0.52	0.06	0.01	0.01	0.53	0.05
Mexico	Colombia	-0.00	0.00	0.08	0.01	0.09	0.01
Mexico	Bolivia	0.00	0.00	0.01	0.00	0.01	0.00
Morocco	Egypt	-0.04	0.00	0.05	0.02	0.09	0.02
Morocco	Ghana	-0.01	0.00	0.01	0.00	0.01	0.00
Morocco	Jordan	-0.02	0.00	0.01	0.00	0.03	0.01
Morocco	Lebanon	-0.02	0.00	-0.00	0.00	0.02	0.01
Morocco	Syria	-0.03	0.00	-0.00	0.00	0.03	0.01
Morocco	Turkey	-0.06	0.00	0.01	0.01	0.07	0.01
Morocco	Tunisia	-0.12	0.01	0.07	0.01	0.19	0.01
Morocco	USA	-0.45	0.02	0.07	0.01	0.52	0.01
Paraguay	Bolivia	-0.10	0.03	0.16	0.02	0.26	0.03
South Africa	Kenya	0.00	0.00	0.01	0.01	0.00	0.01
South Africa	Egypt	0.00	0.00	0.01	0.01	0.00	0.01
Syria	Egypt	0.02	0.00	0.06	0.01	0.04	0.01
Syria	Jordan	0.01	0.00	0.06	0.02	0.04	0.01
Syria	Morocco	0.01	0.00	0.01	0.00	0.01	0.00
Thailand	Malaysia	0.32	0.06	0.76	0.07	0.44	0.03
Thailand	China	-0.01	0.01	0.28	0.02	0.30	0.02
Tunisia	Egypt	-0.06	0.01	0.07	0.02	0.13	0.02
Tunisia	Turkey	-0.01	0.00	0.01	0.01	0.03	0.00
Tunisia	Jordan	-0.03	0.00	0.01	0.00	0.04	0.00
Tunisia	Lebanon	-0.03	0.00	0.00	0.00	0.03	0.00
Tunisia	Morocco	-0.11	0.01	0.05	0.00	0.16	0.01
Turkey	EFTA	0.01	0.00	0.05	0.02	0.04	0.02
Turkey	Egypt	-0.00	0.00	0.05	0.02	0.05	0.02
Turkey	Morocco	-0.00	0.00	0.02	0.01	0.02	0.01
Turkey	Tunisia	-0.00	0.00	0.01	0.01	0.02	0.02
USA	Chile	0.01	0.00	0.04	0.00	0.03	0.00
USA	Morocco	0.00	0.00	0.01	0.00	0.01	0.00
Uruguay	Brazil	-0.05	0.01	0.19	0.03	0.24	0.02
Uruguay	Bolivia	-0.02	0.00	0.06	0.02	0.09	0.02
Uruguay	Chile	-0.22	0.01	0.14	0.02	0.35	0.02

Bootstrap standard errors. The table considers the impact of all PTAs active in the period 2001-2007, on each country's prices and real income. Each line displays the impact for the first named country, implied by its PTA with the second country.

5.2 Did world trade become more or less discriminatory?

The results just presented document the impacts of preferential trade policy. This represents only a share of overall trade policy, as many countries also implement trade barriers reductions outside of trade agreements. This can take the form of MFN tariff reductions, of reductions of applied tariffs below the bound level (for WTO members), or more generally of unilateral barrier reductions granted on non-preferential imports. The theory predicts different impacts from preferential versus non-preferential tariff reductions: preferential trade opening can be detrimental to the country's welfare, if trade diversion prevails. Moreover, we expect "multilateral" opening to be generally more beneficial in real income terms, but less positive for production prices, as it generally does not entail an easier access to partner countries' markets.

At this point, we would like to know whether world trade tends to evolve rather "preferentially" or "multilaterally"; and whether we can understand what factors lead a country to opt rather for the preferential, or the multilateral option.

We start by examining this question at the level of national trade policies. For each country in our model, we consider its unilateral trade policy - i.e., all changes in its tariff structure - and ask what would have been the impact *all else equal.*

Results in table 3 show contrasted profiles across countries. Out of the 42 countries we consider, 23 have had a trade policy that favored the preferential mode of liberalization, in the sense that it made their trade grow faster with their preferential partners. The other 19 countries have had a trade policy that oriented their trade relatively more toward multilateralism.

The table also displays the real income impacts of each country's trade policy. One observes, reassuringly, that most countries have implemented a policy that yielded real income gains. In particular, this is the case also for countries that mostly lead a preferential policy still obtained a positive gain from it, confirming that detrimental effects due to diversion are generally small compared to the gains of preferential opening. Thus, these results offer a more contrasted picture of the evolution of trade policy, than a casual look at the explosion of PTAs might suggest. Most countries implement preferential and multilateral trade barrier reductions concurrently, with the relative importance of the two processes varying across countries. Results on real income effects of these policies suggest that these countries are choosing their trade policy in their best interest: there is no significant difference in the real income impacts of trade policies between the "preferentialist" and "multilateralist" countries.[22] The relative attractiveness of opening trade multilaterally or preferentially varies across countries with the structure of their trade, the importance of trade diversion to be expected from signing a PTA, and the levels of tariffs in the country and in its partners; this should result in different trade policy choices. Testing the optimality of these choices will be the objective of next section.

[22] Grouping countries by the sign of the relative trade growth of preferential over non-preferential trade, we find that the real income effect of trade policy is .13% lower in the first group (s.e. 0.63).

Table 3: Trade and real income impacts of countries' trade policy

	Trade growth (%)		Trade policy impact (%) on
	Preferential	Non-pref.	Real income
Morocco	14.59	-9.64	5.55
Bolivia	11.10	-4.01	2.41
Brazil	14.63	-0.28	1.19
Chile	4.69	-8.01	3.39
Algeria	3.77	-4.98	1.65
South Africa	6.40	-2.24	0.86
Argentina	4.96	-1.89	2.06
China	11.22	5.18	2.95
Tunisia	5.67	1.22	3.42
Malaysia	-0.25	-4.56	3.10
Ghana	4.81	0.85	1.86
Indonesia	1.16	-2.18	0.38
Colombia	2.23	-0.20	0.81
Thailand	6.36	4.26	1.08
EFTA	-0.50	-2.34	-0.93
Canada	-0.08	-1.30	-0.19
Lebanon	0.47	-0.57	0.19
Japan	0.59	0.10	-0.02
Korea	1.63	1.15	0.21
Kenya	-0.51	-0.90	4.53
EU	0.53	0.33	0.03
Venezuela	1.34	1.21	0.25
Ivory Coast	-0.15	-0.02	-0.30
Syria	-0.09	0.11	-0.03
Cameroon	0.08	0.42	0.07
Jordan	1.34	1.83	3.04
Congo	-0.28	0.51	0.26
USA	0.11	1.03	0.03
Taiwan	0.75	1.93	1.63
Nigeria	-0.04	1.29	8.71
Russia	-3.65	-0.69	0.97
Israel	-0.15	3.00	0.56
India	10.44	13.69	6.18
Senegal	-3.33	0.22	-0.13
Ecuador	-1.50	2.37	0.35
Uruguay	-3.19	2.37	2.15
Turkey	-1.24	4.61	0.21
Paraguay	-4.99	2.42	1.64
Mexico	2.81	12.09	1.68
Egypt	4.68	17.93	4.78

This table considers the impact of each country's trade policy on its trade structure, income, all else equal. Trade changes with preferential and non-preferential partners are computed. Real income is the ratio of nominal income to the domestic aggregate CES price index.

Before this, we wish to ask whether world trade is becoming as a whole more or less "preferential", i.e. whether trade between PTA partners is growing faster or slower than that with non-PTA partners. To examine this question, we perform counterfactual estimation of the impact of the two processes separately: in other words, we study two scenarios, one including all tariff reductions between PTA partners, the second including all other tariff reductions, thus being the complementary of the first.

Table 4: Trade impacts of PTAs: treatment effects

	%change in world trade		
	PTAs	non-PTAs	Global
Non-preferential trade	-0.96	2.49	0.31
Preferential trade	2.04	-0.41	1.06

Table 4 shows the results. If only preferential trade barrier reductions had been implemented in 2001-2007, world trade would have increased by 2.04% between PTA, while contracting by almost 1 percentage point among non-partners. Conversely, allowing only non-preferential tariff reductions would have resulted in an decrease in the relative weight of preferential trade. What is interesting is that, overall, tariff changes in that period have made world trade more preferential than not: preferential trade has grown by 1 percentage point, more than three times more than non-preferential trade. This may be surprising given the balance between the orientation of trade policies across countries, but results from the fact that a higher number of large countries have implemented preference-oriented trade policies in the period: the countries with preference-oriented policies represented 67% of total world trade in 2001.

6 Do countries sign the most beneficial PTAs?

We now use our model to examine the following questions: among all possible trade agreements, how do countries choose the ones they sign? Which of the objectives of increasing the country's real income level, or the level of its production prices, is being best served by these choices? Finally, do they optimally choose between the options of preferential and multilateral trade liberalization?

To answer these questions, we perform a simulation exercise in which we compute the impacts, for each country in our sample, of all possible bilateral trade agreements with each other country. We model these agreements as follows: the two countries agree to reduce their tariffs to half the lowest of their two tariffs in each sector. This is intended to capture the reciprocity that applies to most agreements.

Our approach here rests on several hypotheses. First, we assume that the content of a PTA is sufficiently constrained by rules, so that the profile of tariff reductions in any prospective agreement, conditional on initial protection levels, can be predicted with a relative degree of accuracy. The most prominent such rule is article XXIV, paragraph 8b of the GATT (now WTO), which requires that in a PTA "*duties and other restrictive regulations of commerce (...) are eliminated on substantially all the trade between the constituent territories*". In practice, this means that two countries may not sign a "partial" agreement, which would cover only a number of selected sectors. Exceptions are , however, generally admitted to this rule, by which a small number of product lines are being exempted from tariff dismantlement following negotiations between parties. The number of exceptions is generally small, both because of the GATT/WTO rule and because of conflicting interests between negotiating governments, as each country attempts to preserve protection for its strategic industries, while trying to gain market access for all its exporters.

Second, our simulation exercise focuses on one specific aspect of PTA impacts: the terms-of-trade effects of preferential liberalization. Potential determinants of trade policy also include economic factors not accounted for in our framework: in particular specialization gains; as well as non-economic factors. For example, PTAs may favor, or be facilitated by, political links and alliances between partners.

Regarding economic determinants, our hypothesis is that terms-of-trade effects captured in our model constitute the most immediate effects of changing trade barriers; while specialization or productivity gains may take longer to materialize. Assuming that governments have a short-term horizon, one can thus expect terms-of-trade effects to play a role in their decisions. In order to test that our results are not driven by a correlation between these two components of PTA gains, we will perform robustness checks where variables capturing specialization gains are included as controls in our regressions.

As for political determinants, we do not observe them. Our working assumption is that such political links are not systematically correlated with our estimated price impact, which are functions of trade costs and initial trade and protection levels.

Empirical specification We model the probability of two countries signing a PTA with the following functional form:

$$Pr[PTA_{ij} = 1] = F(\beta_1.\widehat{p}_j^{\,ij} + \beta_2.\widehat{P}_j^{ij} + \beta_3.\widehat{(Y_j/P_j)}^{ML}) \tag{18}$$

where F is the logistic function; $Pr[PTA_{ij} = 1]$ is the probability of a PTA being signed between countries i and j; $\hat{p}_j^{\,ij}$ and $\hat{P}_j^{ij}$ are the predicted impacts (relative price changes) of a PTA with country i on country j's aggregate production price p_j and consumer price index P_j, respectively. $\hat{(}Y_j/P_j)^{ML})$ represents the predicted impact of a multilateral reduction of tariff barriers for country i (expressed in relative terms). This latter variable is intended to test whether the options of preferential versus multilateral trade liberalization appear as substitutes in trade policy.

Prospective impacts $\hat{p}_j^{\,ij}$, $\hat{P}_j^{ij}$ are computed by starting from the observed level of protection for all countries in our model in 2001, and simulating the impact of all potential bilateral PTAs between any pair countries, while maintaining status quo on all other trade barriers. PTAs are modeled as described at the beginning of this section. $\hat{(}Y_j/P_j)^{ML})$ is computed as the result of a multilateral opening of country j's trade, modeled as a uniform cut of 50% on all tariffs barriers. The dependent variable is a binary indicator of a PTA being signed between two countries after 2001.

In alternative specifications, we rearrange this functional form as:

$$Pr[PTA_{ij} = 1] = F(\beta_1'.\widehat{p}_j^{\,ij} + \beta_2'.(\widehat{Y_j/P_j})^{ij} + \beta_3.(\widehat{Y_j/P_j})^{ML}) \tag{19}$$

which is equivalent if one recalls that, in the model, national income is the sum of production prices multiplied by fixed volumes : $Y_j = \sum_k p_j^k Q_j^k$. This expression allows to measure with β_2', the impact of expected real income gains on the probability of signing; while β_1' tests whether the impact on production price has any explanatory power, after controlling for real income.

Results are shown in table 5. These results indicate, reassuringly, that the real income gains that a country can expect from signing a bilateral PTA influence trade policy in the right direction, increasing the probability of signing the agreement. It also shows that the potential gains from opening multilaterally decrease the probability of signing a PTA: this indicates that countries with higher expected gains from multilateral opening (due to e.g. more diversified trade across partners, and/or higher average distance from trade partners) tend to engage less in preferential deals.

Decomposing the real income gains from PTAs into production prices on one hand, and domestic aggregate price index impacts on the other (column 2) reveals that these two variables do not carry the same weight in explaining trade policy. The relative gains in production prices have an impact on the probability of signing which are more than two times that of consumer price gains. This difference is significant and robust across specifications.

Column 4 further decomposes the gains from multilateral opening into their production price and consumer price index components. The specification in col. 5 uses country fixed effects, which control for the gains from multilateral opening (invariant across partner countries) as well as for other potential factors impacting PTA choices at the level of countries. These may relate to e.g. countries' size, technology level, trade sophistication, which may affect the gains from PTAs through channels not accounted for in our model. Our main result, the larger impact of producer gains over real income gains is holding in these specifications.

Table 6 tests the relevance of our measures of PTA effects for explaining trade policy. In a seminal paper, Baier and Bergstrand (2004) develop a model of trade which they use to derive a list of determinants of the potential gains from a PTA; they then show that this list allows to correcly predict a number of the agreements which were actually signed. Their model includes several dimensions of the gains from PTAs, including specialization gains. By contrast, our approach is restricted to more specific gains from PTAs, namely terms-of-trade gains; but we measure these gains structurally. To test if our model adds some elements to ther understanding of countries' trade policy, we run in table 6 regressions including the two lists of variables.

Natural is a dummy for two countries being on the same continent. It captures the gains from singing PTAs with so-called 'natural partners', yielding higher gains because of the more intense trade relations. *Remote* is a proxy measure of the distance of two partners from the rest of the world countries, distance which increases the PTA gains as diversion effects are reduced. Finally, *drgdp* is a measure of the gap in income levels between two countries and captures the similarity between two economies.

Results show that although these variables have some power to explain PTAs, they do not exhaust the determinants of countries' trade policy; in particular, our measures of PTA price impacts remain significant.

Finally, table 7 introduces a measure of the losses faced by a country if one of its trade partners engages with a PTA with a third country. Baldwin (1993) has proposed that contagion or "domino effects" may explain the "proliferation" of preferential agreements, as trade diversion from PTAs creates an incentive for non-members to join existing agreements, or to form new ones. Here we test this hypothesis by using a proxy measure of the loss to third countries: for each pair (A,B) of countries, we compute the real income changes for A in scenarios where B signs an agreement with a third country. These changes are negative, due to diversion. We take the maximum loss incurred by A across all potential PTAs signed by B, and use this as a proxy measure of the "diversion threat". This measure is introduced in our specification in column 1, and decomposed in column 2 into the production and price index components. Results indicate that the magnitude of this potential loss relates to the probability of signing an agreement, which tends to confirm the contagion hypothesis. Column 3 we build the PTA "net impacts" on prices, defined as the impact of signing an agreement, minus the loss in the case no agreement is signed and the partner country engages in another PTA. The larger imp

Table 5: Determinants of PTA signing

	(1)	(2)	(3)	(4)	(5)
			$Pr[PTA = 1]$		
Real income impact of bilateral PTA	0.63^a		0.63^a		0.81^a
	(0.10)		(0.10)		(0.14)
PTA impact on production prices		1.42^a	0.79^c	1.44^a	1.32^b
		(0.48)	(0.47)	(0.49)	(0.52)
PTA impact on domestic price index		-0.63^a		-0.63^a	
		(0.10)		(0.10)	
Real income impact of multilateral opening	-0.25^a	-0.24^a	-0.24^a		
	(0.06)	(0.06)	(0.06)		
ML opening: prod. prices				-0.33	
				(0.26)	
ML opening: domestic price index				0.24^a	
				(0.06)	
Country fixed-effects					yes
Observations	1722	1722	1722	1722	1148
Pseudo R^2	0.053	0.056	0.056	0.056	0.136

Standard errors in parentheses.

^{c} p<0.1, ^{b} p<0.05, ^{a} p<0.01

Logit regression on the probability of a PTA being signed between two countries in or after 2001. Impact of each PTA on production f.o.b. prices and on the domestic price index (CES price index) are used in % variation. They are computed at sector level, then aggregated consistently with the model structure. See text for the definition of PTAs in the simulation exercise.

Table 6: Determinants of PTAs: robustness checks

	(1)	(2)	(3)
		$Pr[PTA = 1]$	
PTA impact: production prices	1.21^b	1.21^b	1.17^b
	(0.48)	(0.48)	(0.48)
PTA impact: domestic price index	-0.64^a	-0.64^a	-0.57^a
	(0.10)	(0.10)	(0.11)
Real income impact of multilateral opening	-0.24^a	-0.25^a	-0.24^a
	(0.06)	(0.06)	(0.06)
Natural	0.49^b	0.50^b	0.56^a
	(0.21)	(0.21)	(0.22)
Remote		-0.15	-0.15
		(0.54)	(0.54)
Drgdp			0.09
			(0.06)
Observations	1722	1722	1722
Pseudo R^2	0.062	0.062	0.065

Standard errors in parentheses.

^{c} p<0.1, ^{b} p<0.05, ^{a} p<0.01

Regressions in this table add to the former specification used in table 5 the determinants of PTAs as identified in Baier and Bergstrand (2004). Natural is 1 if the two countries are on the same continent. Remote is the average distance of the two partners to other countries outside the pair. Drgdp is the absolute value of the difference of the log of real GDPs of the two partners.

Table 7: Determinants of PTAs: diversion effects

	(1)	(2)	(3)
	$Pr[PTA = 1]$		
Real income impact of bilateral PTA	0.47^a	0.49^a	
	(0.12)	(0.13)	
Diversion: real income impact	-6.82^a		
	(2.49)		
Diversion: production prices		-4.33^a	
		(1.31)	
Diversion: domestic prices		0.14	
		(3.45)	
Production prices: net impact			1.36^a
			(0.39)
Domestic prices: net impact			-0.59^a
			(0.10)
Real income impact of multilateral opening	-0.24^a	-0.22^a	-0.23^a
	(0.06)	(0.06)	(0.06)
Observations	1722	1722	1722
Pseudo R^2	0.060	0.065	0.060

Standard errors in parentheses.

^{c} p<0.1, ^{b} p<0.05, ^{a} p<0.01

Regressions in this table add estimates of the potential losses by diversion faced by one country if the partner country implements another PTA with a third country. These impacts are decomposed into effects on production prices, domestic CES price index and overall real income impact. "Net impacts" are the difference between the impact of signing a PTA, and the impact if the partner country signs with a third country.

7 Conclusion

What determines trade policy has been a recurrent question in the literature. In this paper we have proposed an original approach to it, based on observing trade policies in the data and looking at the implied trade and income effects. First, we looked at all tariff changes implemented by world countries during 2001-2007, and used a general equilibrium model to compute the implied impacts on trade patterns, and on country real GDP and welfare levels. Although simple, our model essentially captures terms-of-trade effects of preferential and multilateral trade liberalization, thus allowing to quantify trade creation and diversion effects. This exercise reveals that both preferential and multilateral liberalizations are being implemented concurrently by most world countries; overall, about half the countries in our sample have been running a trade policy more multilateral than preferential, thus reducing distorsions in their tariff structure. Next, we found tthe choice of trade policy to be strongly related to both producer and consumer interests, with the former having a weight about two times larger. In contrast to previous estimates in the literature, this result shoows the presence of important distorsions in the setting of trade policy. It suggests that the excessive weight put on market access gains leads countries to exhibit a bias in favor of preferential trade liberalization, despite larger expected gains from multilateral opening.

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Appendices

A Estimation of sector elasticities

Table 8: Sector elasticities estimates

Sectors ISIC	Coeff.	std. error	Obs.	Sectors ISIC	Coeff.	std. error	Obs.
	(1)	(2)	(3)		(1)	(2)	(3)
101	-3.75	2.88	1602	251	-5.97	0.55	7833
102	-4.1	2.52	1250	252	-7.98	0.58	8390
103	-4.1	2.52	1250	261	-8.06	0.63	6871
111	-1.24	0.22	8025	269	-3.22	0.77	7651
112	-0.33	0.29	5584	271	-4.19	0.78	7634
113	-1.95	0.26	7839	272	-7.15	0.93	7097
121	-0.86	0.48	2056	281	-4.63	0.73	5981
122	-0.21	0.29	4697	289	-4.19	0.58	8885
131	-10.8	2.41	3924	291	-6.31	0.72	9006
132	-10.8	2.41	3924	292	-5.46	1.26	8967
141	-5.96	0.99	4321	293	-5.14	0.59	6367
142	-4.96	1.23	5356	300	-6.8	1.44	7819
151	-1.93	0.24	8811	311	-6.48	0.99	7236
152	-1.34	0.31	4312	312	-5.3	0.83	7147
153	-1.03	0.17	5942	313	-7.7	0.83	5818
154	-0.88	0.21	8059	314	-4.5	0.75	5359
155	-0.34	0.11	5826	315	-4.02	0.59	6313
160	-0.66	0.21	3794	319	-4.43	0.84	6734
171	-2.76	0.58	7772	321	-9.44	1.3	6341
172	-3.66	0.51	8150	322	-0.76	0.62	6548
173	-2.72	0.59	7144	323	-3	0.65	6968
181	-2.8	0.38	8400	331	-5.71	1	8203
182	-1.16	0.87	2448	332	-2.09	0.82	5801
191	-4.98	0.57	6929	333	-2.53	0.83	4508
192	-3.6	0.48	6390	341	-3.96	0.47	6633
200	-1.58	0.5	5542	342	-2.84	0.63	4572
201	-4.13	1.1	5112	343	-6.94	0.67	7262
202	-3.62	0.56	7099	351	-4.1	1.4	3596
210	-7	0.69	7445	352	-12.97	2.01	2571
221	-6.71	0.74	6998	353	-7.99	1.66	4541
222	-4.48	0.59	5799	359	-2.56	0.56	5032
231	-4.75	4.03	1164	361	-5.07	0.49	7348
232	-3.69	0.99	6004	369	-0.79	0.21	8759
233	-5.19	2.59	1713	372	-2.38	1.23	1836
241	-8.77	0.87	9059	500	-1.2	0.6	4370
242	-1.31	0.43	9535	742	-6.63	3.27	1366
243	-4.47	1.05	4772	749	-9.91	1.57	1763
				921	-3.27	0.76	4362

Notes: Estimation of sector-level CES demand elasticities based on equation (2). Heteroscedasticity-robust standard errors are reported in parentheses. Estimations use importer-year and exporter-year fixed-effects. The table reports coefficients obtained on the tariff variable, which corresponds to the factor $1-\sigma$ in the model. R^2 vary in the range of 0.6-0.86.